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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/276,376	03/25/99	HUNG	H AM-3245

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EXAMINER	
OLSEN, A	
ART UNIT	**PAPER NUMBER**
1746	12

DATE MAILED: 09/10/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No.	Applicant(s)	
	09/276,376	HUNG ET AL.	
	Examiner	Art Unit	
	Allan W. Olsen	1746	

-- Th MAILING DATE of this communication app ars on the cover sheet with th correspondenc addr ss --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 August 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4 and 12-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *21-29* is/are allowed.

6)☒ Claim(s) *1-4,12-14 and 16-20* is/are rejected.

7)☒ Claim(s) *15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

Cancel claims 5-11

Response to Amendment and Arguments

Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

In view of the amendment and remarks filed August 9, 2001, the rejection under 35 U.S.C. 102(e) of claims 1, 2, 5-9, 12-15 and 17-20 as being anticipated by Araki is withdrawn.

The terminal disclaimer filed on August 9, 2001 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on application 09/405,869 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Specification

The disclosure is objected to because of the following informalities:

page 14, lines 1-3: a flow window of 4 sccm about a central point of 12 sccm is said to represent a process window of 25%.

Appropriate correction is required.

Claim Objections

Claim 4 is objected to because of the following informality: An apparent word processing operation gone awry has left extraneous words and punctuation at the end of claim 4.

Appropriate correction is required.

Withdrawal of Indicated Allowable Subject Matter

The indicated allowability of claims 3 and 4 is withdrawn in view of the newly discovered references to Hung and Fukuta. Rejections based on the newly cited references follow.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 17 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 17 requires the creation of a DC bias upon the pedestal electrode. The examiner finds no disclosure pertaining to this aspect of the invention in the originally filed specification.

Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 16 pertains to a process having a process window of 25%. The specification discusses tolerable variations in flow rates (i.e. the size of the process window) in terms of a plus or minus percentage (e.g. ± 20%). In view of the ± notation used in the specification, it is not clear if "a 25% process window " is intended to allow for a variation in flow rate of ± 25% or ± 12.5%.

Claim Rejections - 35 USC § 103

Claims 1-4, 12-14 and 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,174,451 issued to Hung et al. (hereinafter, Hung) in view of U.S. Patent 5,770,098 issued to Araki et al. (hereinafter, Araki).

Hung teaches the use of C_4F_6 to etch an oxide layer selectively with respect to an underlying nitride layer. Hung provides specific examples in which argon is added to the C_4F_6. Hung teaches that, in place of argon, any inert gas may be used. Hung

teaches a method in which the process window for the C_4F_6 flow rate is ± 15%. Hung teaches against the inclusion of CO. Hung method is used to etch an oxide having an underlying nitride layer wherein the nitride layer comprises a corner feature. Hung's method is a two step process. The first step forms holes in the oxide layer. Therefore, the second step is carried out on an oxide layer having pre-formed holes. Hung teaches the use of an apparatus that provides a remotely generated, inductively coupled, RF plasma. Hung teaches applying 1600 W of RF power to the substrate supporting electrode. See: abstract; fig. 1; column 9, lines 5-40; column 10, lines 58-61.

While Hung teaches that any inert gas can be used, Hung does not explicitly refer to xenon.

Araki teaches a method similar to that of Hung in that C_4F_6 is used to selectively etch an oxide. Araki teaches adding argon to C_4F_6 such that the Ar:C_4F_6 ratio is 20:1. Araki also explicitly teaches the functional equivalence of argon and xenon.

It would have been obvious to one skilled in the art to use xenon with Hung's method, in place of the argon, because Hung teaches that any inert gas can be used. Furthermore, Araki teaches that in Ar and Xe are functionally equivalent in a method that uses the same fluorocarbon etchant to selectively etch an oxide. It would have been obvious to use a Ar:C_4F_6 ratio of 20:1 because Araki teaches that the selectivity towards photoresist increases as the ratio increases to 20:1 (figure 11).

Claims 1 and 2 are rej cted under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent Publication Hei 9-191002 (hereinafter, Fukuta) in view of Araki.

Fukuta teaches a method of etching of an oxide layer that is highly selectivity with respect to an underlying nitride layer. Fukuta's RF powered, plasma etching method uses C_4F_6 as the etchant. Fukuta generically teaches that C_4F_6 can be mixed with an inert gas. Fukuta teaches against the inclusion of CO in the etching gas mixture.

Fukuta does not teach the using the inert gas in an amount that is greater than or equal to the amount of C_4F_6.

Araki teaches a method of plasma etching an oxide layer. Araki teaches adding an inert gas, including xenon, to a fluorocarbon etchant, including C_4F_6. Araki teaches using an inert gas: fluorocarbon ratio of up to 20:1.

When needing to etch an oxide layer selectively with respect to an underlying nitride layer, one skilled in the art would be motivated to incorporate Araki's 20:1 C_4F_6 / Xe mixture in the method of Fukuta because Fukuta teaches that a C_4F_6 / inert gas mixture can be used to etch an oxide layer selectively with respect to an underlying nitride however Fukuta fails to provide details pertaining to various process parameters, such as the specific inert gas and flow ratios that are to be used. In this vacuum of information the skilled artisan would be motivated to incorporate Araki's 20:1 C_4F_6 / Xe mixture into the method of Fukuta because Araki teaches the same selective etch using the same gases but Araki provides the details not found in Fukuta.

Claims 1, 2, 12-14 and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,069,092 issued to Imai et al. (hereinafter, Imai) in view of Fukuta.

Imai teaches a plasma etching method to etch an oxide layer selectively with respect to an underlying non-oxide layer. Imai teaches using C_4F_6 / Xe mixture as the etching gas. Imai teaches applying up to 2000 W of RF power to the substrate supporting electrode. Imai teaches the use of an inductively coupled plasma. Imai also teaches that reactors with remote plasma generation may be used. See: abstract; figures 3 and 4; col. 2, lines 8-12; col. 4, lines 34-42; col. 7, lines 43-50; col. 7, line 63 – col. 8, line 5.

Imai does not teach etching an oxide selectively with respect to a nitride.

Fukuta teaches that one can etch an oxide layer selectively with respect to an underlying nitride layer by using an etchant comprising C_4F_6 and an inert gas.

As suggested by Fukuta, the need to etch an oxide layer selectively with respect to an underlying nitride layer is frequently encountered in the manufacturing of integrated circuits or semiconductor devices. It would have been obvious to one skilled in the art, to use the method of Imai to etch an oxide with an underlying nitride because both Imai and Fukuta teach using a mixture of C_4F_6 and an inert gas to etch an oxide layer. Fukuta teaches that the C_4F_6 / inert gas mixture can be used to etch an oxide layer selectively with respect to an underlying nitride layer but Fukuta fails to provide specific details relating to various process parameters. The teachings of Imai parallel those of Fukuta in the sense that the same gases are used to etch an oxide layer selectively with respect to an underlying non-oxide layer. However, Imai provides the specific details that are absent from Fukuta. Therefore, when faced with the frequently occurring need to etch an oxide layer selectively with respect to an underlying nitride layer, a skilled artisan could use Imai's method, in view of Fukuta, and have a very high expectation of success.

Claims 1, 2, 12-14 and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Araki in view Fukuta.

Araki teaches etching an oxide layer selectively with respect to an underlying nitride layer using a plasma of C_4F_6, C_4F_8 or C_6F_6 in conjunction with Xe that is supplied at a rate 20 times greater than the rate at which the fluorocarbon is supplied. Araki teaches that benefits may be obtained upon adding CO to the etching gas mixture. Nevertheless, Araki teaches that oxide selectivity can be achieved with a CO free etching process (see column 6, line 65 – column 7, line 1, and figures 5 and 6). Araki teaches applying up to 2500 W of RF power to the substrate supporting electrode. Araki also teaches that various types of plasma reactors can be used including ICP reactors and those with remote plasma generation.

Araki does not teach excluding CO when using C_4F_6 as the fluorocarbon etchant.

Fukuta teaches a method using a C_4F_6 / inert gas mixture to etch an oxide layer selectivity with respect to an underlying nitride layer. Fukuta teaches against the inclusion of CO in the etching gas mixture.

It would have been obvious to one skilled in the art to extend Araki's teaching of excluding CO from an etching gas that comprises C_4F_8 to excluding CO when the etchant comprises C_4F_6 for the following reasons. Araki teaches that one can selectively etch an oxide when the etchant comprises C_4F_8 but excludes CO. Araki teaches the functional equivalence of C_4F_8 and C_4F_6. From this alone, one skilled in the art would have a reasonable expectation of success when etching an oxide with an etchant comprising C_4F_6 but excluding CO. This reasonable expectation would be very strongly supported by Fukuta's teaching that a CO free etchant that comprises C_4F_6 and

an inert gas may be used to etch an oxide layer selectivity with respect to an underlying nitride layer. One skilled in the art would be motivated to use C_4F_6 in Araki's method but forego the addition of CO because Fukuta teaches that the addition of CO, while offering gains in selectivity, also leads to a reduction in the etching rate. Fukuta teaches that other etching characteristics are prone to such a trade-off relationship as well. Furthermore, Fukuta teaches that there are significant safety concerns associated with the use of CO.

Allowable Subject Matter

Claims 15 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 21-29 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: The novel and non-obvious feature of the instant invention is the combined limitations of using a fluorine compound and an equal or greater amount of Xe to etch an oxide layer selectively with respect to an underlying non-oxide. Also required is that the process be conducted upon an oxide with pre-formed holes and in the process, the top surface of the oxide has corners that are exposed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is (703) 306-9075. The examiner can normally be reached on Monday through Friday from 9:30 to 6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski, can be reached on (703) 308-4333. The fax phone number for this Group is (703) 305-7719.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.
August 24, 2001

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